some vertical sections show extensive folding, faulting, and foliation of the ice strata.

It is concluded that pressure has had a very important rôle in determining variations in the course of the glaciers, surface forms on the glaciers, especially hillock moraines, stratification, and local deformation of the ice, and in the erosion accomplished.

R. C. M.

The Squantum Tillite. By ROBERT W. SAYLES. Bull. of the Museum of Comparative Zoölogy, Harvard College, Vol. LVI, No. 2, Geological series, Vol. X, 1914. Pp. 141–75, pls. 12.

The origin of the Roxbury conglomerate has always been a matter of doubt. It has been held by a number of geologists to be of glacial origin, while yet others have favored its marine derivation.

Robert W. Sayles in the present paper describes a bed of what appears to be tillite in the Roxbury series of Boston and vicinity. The Squantum tillite has a probable thickness of 600 feet and consists of sand, angular, subangular, and rounded pebbles and bowlders, and irregular fragments of slate. The size of the fragmental material varies from that of a sand grain to large, angular blocks, one bowlder having been found which has a length of 6 feet and a width of 1 foot. Practically all of the material is less than a foot in diameter, with the greater proportion less than 6 inches. All of these fragments are firmly cemented in a matrix of argillite. There are also intercalated beds of slate and conglomerate.

The criteria necessary for the recognition of tillite are enumerated and their application has been made to seventeen outcrops of this apparently glacial material. Mr. Sayles presents strong evidence in favor of the glacial origin of the Squantum tillite. The illustrated bowlders and pebbles have a subangular outline and also show fairly distinct striae. A striated bedrock has not been found, but this may be due to the nature of the underlying rocks, which are slates and sandstones.

In one locality the contact with the tillite and underlying sandstone was very ragged, the suggestion being made that the sand deposit, before having been firmly cemented, had been disrupted by violent movements of the ice.

The supposition is made that the movement of the glacier was from the southeast, and that as the advance took place into the Boston basin, the recently deposited beds of sand and clay were torn up and the fragments mingled with the débris of the glacier. The intercalated beds of slate, which become more numerous toward the top of the tillite, are

indicated as representing successive lengthening of the periods of the ice retreat, the slate present above the tillite representing the final retreat of the ice, followed by subsidence and deposition.

The age of the Squantum tillite is given as Permo-Carboniferous, with a probability that because of the widespread Permian glaciation it may be Permian.

C. B. A.

"Die Gletscher des Sarekgebirges und ihre Untersuchung." By AXEL HAMBERG. *Sveriges geologiska undersökning*, Ser. Ca., I, 4:0, No. 5. Pp. 26 (4mo), pls. 4.

The Sarekgebirge are the largest range in Sweden and contain more than 100 glaciers. Increase of snowfall toward the west, lower temperature in the north, and elevation above the sea determines the location of the larger and greater number of glaciers in the high, northwest part of the range. Winds are very strong, so topography has a very important influence in the locations of snow-fields. At high altitudes, however, the work of hoarfrost (*Rauhfrost*) to some extent counterbalances the effect of the wind. Two types of glaciers are distinguished: (1) valley glaciers, mostly in young cirquelike valleys at the edge of the upland, ranging in length from a few hundred meters to 5 or 6 km.; and (2) plateau glaciers which form on the broadly undulating flat tops of some of the mountains. The latter are not like the convex surface *Inlandeistypus* of Norway. Cliff glaciers are present, also, in very subordinant number.

Experiments were made to determine the yearly snow accumulation at various points on some of the larger ice-fields. This was done by means of marked standards and showed:

At 1,200 m. elevation	0 accumulation = snow line
1,340 m. elevation	1.29 m. accumulation per year
1,440 m. elevation	2.16 m. accumulation per year
1,500 m. elevation	2.43 m. accumulation per year

Observations on the rate of melting at the surface of the glaciers were undertaken by means of bored holes, the bottoms of which were specially marked. This showed a very rapid decrease of melting with increased distance from the lower edge of the ice.

Dist. from glacier end (m.)	150	350	1,000	2,000
Elev. above sea (m.)	970	1,000	1,100	1,200
Melting in 1 year (cm.)	330	244	90	4